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Abstract

This paper analyzes the effects of Inflation Targeting (IT) and Fiscal Rules (FR) on fiscal behaviors and inflation dynamics. Its main novelty is twofold: first, it is the first study which accounts explicitly for the role of the interactions between IT and FR regarding their fiscal and inflationary effects. Second, it questions the optimality of the sequence of adoption of IT and FR. Using a wide panel of 152 developed and developing countries over the period 1990-2009, we find that adopting both IT and FR leads to better fiscal and monetary outcomes than adopting only FR or only IT. In addition, we highlight the dominance of the sequence which consists of introducing first FR before adopting IT with respect to the opposite sequence, regarding their fiscal and inflationary effects.

JEL Codes: E31, E52, E58, E63, H62

Keywords: Inflation Targeting, Fiscal Rules, Interactions, Sequence of Adoption

1. Introduction

This paper is concerned with filling a gap in the existing literature on the effects of Inflation Targeting (IT) and Fiscal Rules (FR), namely the failure of taking into account the influence of likely interactions between IT and FR when it comes to assessing their respective macroeconomic performances.[1] Indeed, previous studies evaluated the respective effects of IT and FR separately. On the fiscal side, a substantial strand of empirical literature emphasized that FR are effective in delivering fiscal discipline (Alesina & Perotti, 1995; Alesina et *al*., 1999; Debrun et *al*., 2007; Hallerberg et *al*., 2009; Dabla-Norris et *al*., 2010; or Gollwitzer, 2011). On the monetary side, IT adoption was found successful in bringing down inflation and its volatility, notably in developing countries (Batini & Laxton, 2007; Gonçalves & Salles, 2008; Lin & Ye, 2009; or de Mendonça & de Guimarães e Souza, 2011).

However, a common drawback to both sets of studies is that papers having assessed the fiscal impact of FR (the inflationary impact of IT) did not take into account the potential effects of IT on fiscal behaviors (of FR on inflation dynamics). On the one hand, the discipline-enhancing effects on the conduct of fiscal policy attributed to FR may also stem partly from IT adoption, as the latter may serve as a catalyst for the implementation of sound fiscal policies. Indeed, Mishkin (2004), Roger (2009) or Freedman & Ötker-Robe (2010) defend the idea that, to prevent the central bank from missing its inflation target due to pressure from the government to monetize the public debt, IT adoption may be sufficiently binding for both the central bank and the government to serve as a good device to ensure fiscal discipline.[2] On the other hand, fiscal discipline has been identified as a key prerequisite for the effectiveness of IT in achieving price stability (Masson et *al.*, 1997; Sims, 2004; or Bernanke & Woodford, 2004). Given that FR adoption is considered as a pivotal element in setting off fiscal discipline, the favorable inflationary effects attributed to IT in the literature may also be partly related to the presence of FR, rendering more credible the IT framework regarding the private sector's inflation expectations.

[1] IT is a new framework for monetary policy, characterized by five main criteria, namely (i) public announcement of a medium-term inflation target, (ii) institutional commitment to price stability as the primary goal of monetary policy, (iii) forward-looking strategy for inflation forecasts, (iv) enhanced transparency, and (v) greater accountability of central bank in achieving its inflation target (for an extensive discussion, see, *e.g.*, Svensson, 1997, or Mishkin, 2000). FR are "*a permanent constraint on fiscal policy, expressed in terms of a summary indicator of fiscal performance, such as government budget, borrowing, debt, or a major component thereof*" (Kopits & Symansky, 1998, page 2).

[2] In addition, given that low inflation rates are likely to mitigate the Oliveira-Keynes-Tanzi effect (i.e. the erosion in the real value of taxes between the date of imposition and the date of collection, see Tanzi, 1992) and that IT has been found to reduce inflation rates, a mechanical favorable effect on fiscal balances may thus follow IT adoption.

Consequently, there are good arguments for assuming that studying the effects of IT and FR respectively on inflation and on fiscal balances without taking into account the influence of interactions between them can lead to misleading conclusions. Such a reasoning is all the more welcomed that IT (or FR) was sometimes adopted as part of broader reforms aiming at strengthening macroeconomic stability; for instance, IT adoption sometimes went along with the introduction of bold fiscal reforms, including the establishment of FR, to support the IT framework (for example in Brazil, Norway, New Zealand or Sweden). In some countries (for instance, Brazil, Chile, Israel, Norway, Poland, Romania or United Kingdom), legislation measures prohibiting monetization of public debt, which are a form of FR, were adopted to ensure the credibility of the commitment to the inflation target, while in other countries (such as Australia, Canada, Czech Republic, Ghana, Indonesia, New Zealand, Philippines, South Africa or Turkey), the inflation target is jointly defined by the central bankers and the government, to clearly signal that both fiscal and monetary authorities are committed to hit the inflation target. Altogether, these arguments point out that the effectiveness of IT and FR in affecting inflation and the fiscal stance may depend on whether IT (FR) is implemented alone or jointly with the introduction of FR (IT). Put differently, interactions between these rule-based policy frameworks seem to matter on their individual inflationary and fiscal effects.

An additional motivation for our analysis stems from the fact that both IT and FR are rule-based policy frameworks with the same ultimate goal, namely conferring credibility to macroeconomic policies in general, as stressed out by Kopits (2001); as such, they may act complementarily in achieving this common ultimate goal, all the more that both frameworks experience concomitantly a growing popularity since the early nineties. Furthermore, both IT and FR display many similarities in their nature, as they are defined in the form of numerical targets on macroeconomic aggregates, namely on inflation for IT and on fiscal variables for FR, with the goal of constraining the discretion of monetary and fiscal authorities respectively.[3] Given this marked parallelism in the implementation of both frameworks, it is reasonable to explore the likely role of their interactions when it comes to isolating their respective causal effects on inflation dynamics and fiscal behaviors. From a broader viewpoint, the influence of the interactions between IT and FR can be linked to the bourgeoning literature on the price level determinacy, inspired by the seminal paper by

[3] In addition, IT and FR equally display similarities in their institutional parameters, as illustrated in the comparative description of their main features (see Appendix 1). Indeed, as pointed out by Kopits (2001), the new wave of FR, started in New Zealand in 1994, is backed up by institutional parameters which are also present in IT frameworks, such as transparency and accountability mechanisms.

Sargent & Wallace (1981), or the more recent fiscal theory of the price level (Woodford, 1994). This literature (see, *e.g.*, Aiyagari & Gertler, 1985; Sims, 1988; Leeper, 1991; Benhabib et *al.*, 2001; Uribe, 2006; or Sims, 2011) is interested in disentangling the relative importance of monetary policy versus fiscal policy when it comes to providing the nominal anchor to the economy. Accordingly, by pointing out that fiscal (monetary) policy may alter the way monetary (fiscal) policy affects inflation dynamics, these authors laid the foundations for taking into account the role of the interactions between monetary and fiscal policies regarding their respective macroeconomic effects.[4]

In light of this literature, we question in this paper the interactions between IT and FR in terms of their effects on inflation and fiscal balances, by focusing on two issues. First, we explore if the joint effects of IT and FR on inflation and fiscal balances are larger compared to their isolate effects. Second, we investigate the role of the sequence (or timing) of IT and FR adoption. Put simply, do interactions between IT and FR influence differently inflation and/or fiscal balances depending on whether a country adopts IT before introducing FR, or inversely?[5] To this end, we perform System-GMM estimations, which properly address the likely endogeneity in the adoption of both IT and FR and in their interactions and sequence of adoption, in addition to accounting for inertia in inflation dynamics and in the budget process. First, we find that adopting both IT and FR improves primary (and overall) fiscal balances and brings down average inflation more than compared to the cases where only FR or only IT are adopted. Second, we highlight the dominance of the sequence which consists of introducing first FR before adopting IT with respect to the opposite sequence, regarding their fiscal and inflationary performances.

The rest of the paper is organized as follows. Section 2 presents the dataset and displays some stylized facts. Section 3 discusses the methodology and the estimation technique. Section 4 illustrates the main results and their robustness, and section 5 concludes.

[4] To characterize cases in which fiscal policy, rather than monetary policy, may provide the nominal anchor to the economy, Sargent & Wallace (1981) distinguish two policy regimes, namely "*monetary dominance*" and "*fiscal dominance*". Under a *fiscal dominance* regime, the primary fiscal balance evolves independently of the public debt, causing the equilibrium level of price to raise in order to ensure government's fiscal solvency; in this case, the nominal anchor is provided by fiscal policy, meaning that a restrictive monetary policy may even result in higher inflation if the main source of government funding is seigniorage, and if the primary fiscal balance is not adjusted after seigniorage receipts collapse. On the contrary, under *monetary dominance* the primary fiscal balance evolves consistently with government's fiscal solvency, so that the equilibrium price level is determined according to the traditional way, namely through the interaction between the supply and the demand for money.

[5] A comparable strategy was adopted for exploring the complementarities and the optimal order of financial liberalization reforms (see, *e.g.*, Dewatripont & Roland, 1995; or de Macedo & Martins, 2008) or political liberalization versus economic liberalization reforms (see Giavazzi & Tabellini, 2005).

2. Data and Stylized Facts

We build upon a wide panel of 152 developed and developing countries over the period 1990-2009 (see Appendix 2 for the list of countries). The number of countries in the sample is limited exclusively on the basis of data availability, especially regarding outcome variables, namely fiscal balances (primary or overall) and the inflation rate. Regarding the time coverage, the sample starts in 1990 because reliable fiscal data exist only from 1990, all the more in developing countries, which are largely present in our sample.

2.1. Variables of interest: Inflation Targeting and Fiscal Rules

IT is measured by a binary variable equaling one if at a given year a country uses IT as its framework for the conduct of monetary policy, and zero otherwise. Data on the starting dates of IT come from Rose (2007), and were updated from Roger (2009) for recent experiences of IT adoption, namely between 2005 and 2009. Rose (2007) distinguishes two kinds of dates, namely *default* starting years and *conservative* starting years. The difference between the two dates captures the fact that some central banks initially adopted "soft or informal" IT (Vega & Winkelried, 2005), in which the central bank's reaction, following a deviation of inflation from its targeted level, is slower compared to its reaction under an explicit "full-fledged or formal" IT. Consequently, *default* starting dates (or soft IT) are those declared by central banks themselves, while *conservative* starting dates (or full-fledged IT) are those considered by academia as the genuine dates since the central bank began meeting the required criteria to be classified as an Inflation Targeter (ITer). For robustness issues, we perform our analysis on both dates in the following sections. Among the 152 countries in the sample, 29 experienced IT by the end of 2009 (see the first column of Appendix 3 for the list of 29 ITers along with their starting dates).[6]

We measure FR by a binary variable taking the value one if at a given year a country placed a numerical constraint on fiscal aggregates (budget balance, spending, revenue or debt) at the national level. Data on the starting dates of FR come from the new Fiscal Rules Database (IMF's Fiscal Affairs Department, Fiscal Policy and Surveillance Division, 2009), providing a comprehensive overview on FR experiences around the world. Among the 152

[6] Serbia adopted IT in 2006, but due to lack of data on fiscal balance, this country is dropped from the sample. Remark that 3 countries, namely Finland, Spain and Slovak Republic, adopted IT in 1993, 1995 and 2005 respectively, but the first two abandoned IT to join the Euro area in 1999, while the third did so in 2009. Consequently, we consider them as ITers only from their IT adoption date to their entrance date to the Euro area.

countries in the sample, 51 enacted Fiscal Rules (FRers) by the end of 2009 (see the second column of Appendix 3 for the list of 51 FRers and their starting dates).[7]

2.2. The interaction between IT and FR and the sequence of adoption

To explore the potential impact of the *interaction* between IT and FR and of the *sequence* (timing) *of adoption* of IT and FR, we build the five following dummy variables (see columns three to seven in Appendix 3):

(i) A binary variable, called IT_only, equaling one after IT adoption in countries having *adopted only IT* (these countries should have not adopted FR throughout the entire time coverage of the sample, namely 1990-2009), and zero otherwise. For example, South Africa adopted IT in 2000 and did not experience FR at all over 1990-2009; accordingly, for South Africa, IT_only equals zero for 1990-1999, and one for 2000-2009;

(ii) A binary variable, called FR_only, equaling one after FR adoption in countries having *only enacted FR* (these countries should have not adopted IT throughout the entire time period of the sample, namely 1990-2009), and zero otherwise. For example, India adopted FR in 2004 and did not experience IT at all over 1990-2009; accordingly, for India, FR_only equals zero for 1990-2003, and one for 2004-2009;

(iii) A binary variable, called IT_&_FR, equaling one after the adoption of the *first regime* in the countries having adopted *both* IT and FR, and zero otherwise. This dummy variable captures the effect of the first regime and is pivotal (altogether with the two following dummies) for identifying the strategic interaction (complementarity/substitutability) of adopting both IT and FR. For example, Australia adopted both IT and FR, the former in 1993 (default starting date) and the latter in 1998; accordingly, for Australia, IT_&_FR equals zero for 1990-1992 and one for 1993 to 2009. Similarly, Poland adopted both frameworks, but first introduced FR in 1997 and then IT in 1998; accordingly, for Poland, IT_&_FR equals zero for 1990-1996 and one for 1997-2009;

(iv) A binary variable, called IT_after_FR, capturing the *sequence of adoption*, equaling one after IT adoption by countries having first enacted FR and then adopted IT, and zero otherwise. For example, Poland enacted FR in 1997 before adopting IT in 1998; accordingly, for Poland, IT_after_FR equals zero for 1990-1997 and one for 1998-2009;

[7] Armenia, Comoros, Hong Kong, Liberia, and Timor-Leste enacted FR in 2008, 2001, 1997, 2004 and 2005 respectively, but due to lack of data on fiscal balances and/or inflation they are dropped from our sample. Remark that the United States (US) introduced FR in 1990, but abandoned it in 2002, so as Belgium in 1992 and 1999 respectively. Consequently, we consider the USA as a FRer for the 1990-2002 period and Belgium as a FRer for the 1992-1999 period.

(v) A binary variable, called FR_after_IT, capturing the *sequence of adoption*, equaling one after FR adoption by countries having first adopted IT and then enacted FR, and zero otherwise. For example, Australia adopted IT in 1993 before enacting FR in 1998; accordingly, for Australia, FR_after_IT equals zero for 1990-1997 and one for 1998-2009.

2.3. Outcome variables

We consider three outcome measures, two to capture the performances related to fiscal authorities, namely the Primary Fiscal Balance and the Overall Fiscal Balance, and the third to seize the performances of monetary authorities, namely the annual Inflation Rate. The overall fiscal balance (FB) is the difference between General Government revenue and expenditure, while the primary fiscal balance (PFB) excludes interest payments from expenditure. The inflation rate (Inflation) is defined as the annual growth rate of the average Consumer Price Index. Appendices 4 and 5 provide data definitions and descriptive statistics.

2.4. Stylized Facts

Let us have a closer look at these variables by exploring descriptive statistics. Among the full sample of 152 countries, 92 countries (60.53%) did not commit to neither IT nor FR. Within the 29 ITers, 9 countries (31.03%) adopted only IT (*i.e.* they did not enact FR in addition to IT), while 31 out of the 51 FRers (60.78%) enacted only FR. As a result, from the 60 countries having adopted either IT or FR, 20 countries (33.33%) opted for both IT and FR (Appendix 3 presents a detailed classification of each category of countries).

Before setting out the econometric analysis, we present in the following simple correlations between the five above-defined dummies and the outcome variables (fiscal balances and inflation), for country pairs displaying reasonable similarities in their economic structures. Figure 1 below displays the evolution of the PFB in Sweden, which adopted both IT and FR, the former in 1993 (default starting date) and the latter in 1996, and in Austria, which enacted only FR in 1999. According to Figure 1, Sweden experienced on average a larger improvement in its PFB in the years following the starting date of both regimes, compared to Austria after its FR adoption (4.12 vs. 1.27 percentage points of GDP, respectively). These statistics may indicate the presence of complementarity between IT and FR in shaping fiscal behaviors, as adopting both frameworks (IT and FR) is associated with more durable primary surpluses than adopting only one framework. A similar conclusion emerges from Figure 2, which displays the evolution of Inflation in Peru, which adopted FR

in 2000 and IT in 2002, and in Philippines, which adopted only IT in 2002. According to Figure 2, adopting both frameworks leads to better inflationary performances on average, compared to adopting only one framework (since the beginning of its first regime in 2000, the average inflation decreased by around 4.23 percentage points in Peru, against 1.04 after the IT adoption in Philippines).

Figure 1. PFB: IT_&_FR vs. FR_only

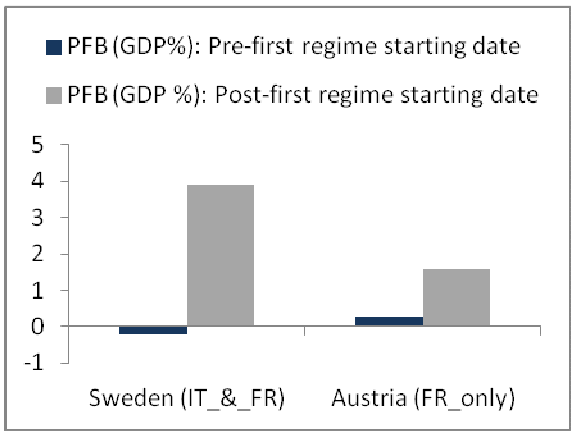
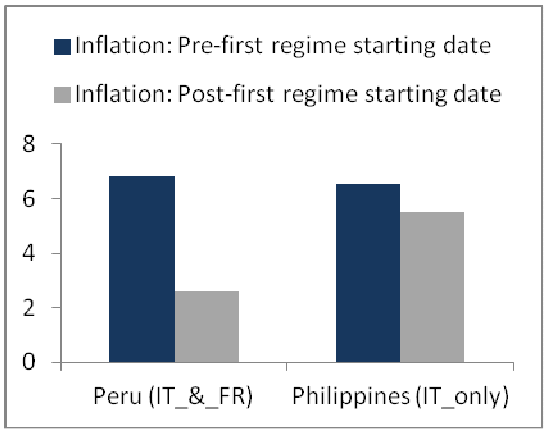


Figure 2. Inflation: IT_&_FR vs. IT_only



We turn now our attention to the issue of the sequence of adoption. According to Figure 3, the Slovak Republic, which enacted FR in 2002 before committing to IT in 2005, ran lower primary deficits since the beginning of its first regime compared to the Czech Republic, which adopted first IT in 1998 before enacting FR in 2005. Indeed, the PFB in the years following the starting date of the first regime improved on average by around 3.91 and 1.05 percentage points of GDP in these countries, respectively. The likely dominance of the IT_after_FR sequence over the FR_after_IT sequence equally emerges when considering Inflation as the outcome variable. As illustrated by Figure 4, Poland, which enacted FR in 1997 before adopting IT in 1998, reduced further its inflation rate since the beginning of the first regime compared to the Czech Republic, which opted for the opposite sequence, namely IT adoption in 1998 before enacting FR in 2005 (10.46 vs. 7.71 percentage points).

Figure 3. PFB: IT_after_FR vs. FR_after_IT

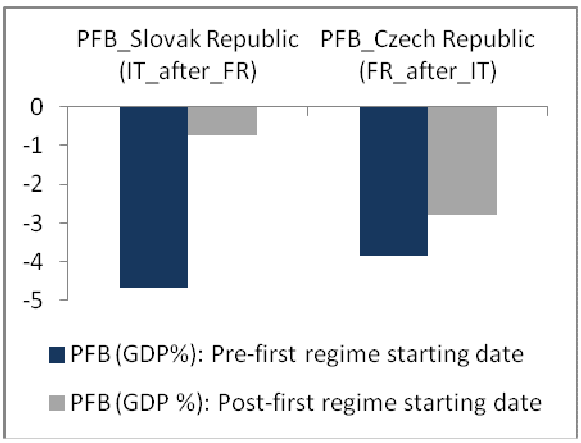
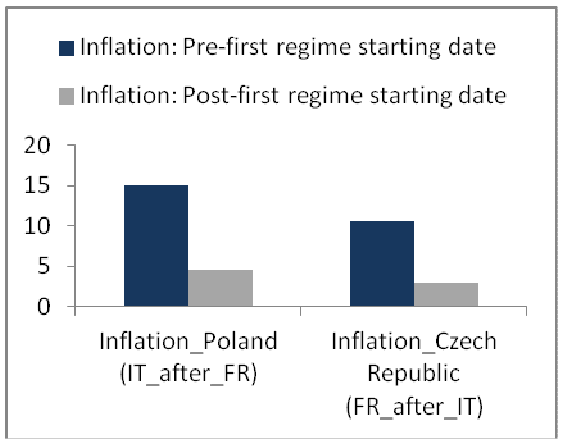


Figure 4. Inflation: IT_after_FR vs. FR_after_IT



To summarize, these simple stylized facts do not go against (i) a potential complementarity between IT and FR regarding their effects on fiscal balances and inflation, and (ii) a potential importance of the sequence of adoption of the two frameworks. Consequently, we investigate in the next sections the strength of these relationships using a more robust econometric setup.

3. Methodology

As previously acknowledged, we aim at exploring the influence of interactions between IT and FR, and of the sequence of adoption of IT and FR in shaping fiscal behaviors and inflation dynamics. To this end, let us consider the following general model dealing with the isolate effect of IT (or FR) on the *outcome* variables

$$PFB_{it} = \alpha + \beta\, PFB_{it-1} + \lambda_1 IT_{it} (\text{or } \lambda_1 FR_{it}) + \delta_1 Debt_{it-1} + \phi X_{it} + v_i + n_t + \varepsilon_{it}, \quad (1a)$$

$$Inflation_{it} = \alpha + \beta\, Inflation_{it-1} + \lambda_1 IT_{it} (\text{or } \lambda_1 FR_{it}) + \phi X_{it} + v_i + n_t + \varepsilon_{it}, \quad (1b)$$

where IT and FR stand for the inflation targeting and fiscal rules dummy respectively, X_{it} is a vector of control variables, v_i and n_t denote country and time fixed effects respectively, and ε_{it} is the error term. Relation (1a) captures the effect of IT (or FR) on the primary fiscal balance and is adapted from the standard Bohn's (1998) model, which links a country's primary fiscal balance to the past level of its government debt, the business cycle fluctuations and to a set of politico-institutional variables.[8] As control variables, we therefore include the lagged value of the PFB (to account for persistency in the budget process), the lagged government debt (to control for the sensitivity of the PFB to past debt developments, consistently with the need for fiscal solvency), the output gap (to seize the effect of business cycle fluctuations) and government stability (to control for the politico-institutional context). We also control for trade openness and the growth rate of terms of trade (to account for the effects of external shocks), and the logarithm of real per capita GDP (to account for country's status of development).[9] Relation (1b) models the inflationary effects of IT (or FR) and includes the same determinants as (1a), except for the inclusion of the lagged value of inflation instead of the lagged PFB (to seize the persistency in inflation dynamics), and for the absence of lagged government's debt.[10]

[8] Remark that relation (1a) employs alternatively IT and FR as variable of interest, each case corresponding to a test of the discipline-enhancing effect of IT and FR, respectively; the same applies to relation (1b), which models the inflationary effect of IT and FR, respectively.

[9] Sources, definitions and descriptive statistics of all variables are presented in Appendices 4 and 5.

[10] Controlling for government debt may not make sense in that it might capture entirely the effect of FR on Inflation, for instance. Indeed, one of the main channels through which FR may affect Inflation is government

As outlined above, the inclusion of IT (or FR) in equations (1a) aims at capturing the ability of IT (or FR) regimes to rule-out the so-called *deficit bias*, namely the tendency of governments to run permanently fiscal deficits due to their willingness to manipulate fiscal policy for electoral purposes (see, for example, Fatás & Mihov, 2003, or Debrun et *al.*, 2007). The coefficient of interest is captured by λ_1, which measures the effect of IT (or FR) on the outcome variable. With respect to our hypothesis that IT and FR adoption has a discipline-enhancing effect on the conduct of fiscal policy, we expect λ_1 to be positive when using the PFB or the FB as outcome variable (equation (1a)). On the contrary, given the hypothesis that IT and FR allow tackling the inflationary bias inherent to the so-called time inconsistency problem, we expect λ_1 to be negative when using Inflation as the outcome variable (equation (1b)).

Starting from the general setup (1a-b), we explore the role of interactions between IT and FR, and of the sequence of adoption of IT and FR on our outcome variables using the following model

$$\begin{aligned} PFB_{it} = {} & \alpha + \beta\, PFB_{it-1} + \lambda_1 IT\_only_{it} + \lambda_2 FR\_only_{it} + \lambda_3 IT\_\&\_FR_{it} \\ & + \lambda_4^1 IT\_after\_FR_{it} + \lambda_4^2 FR\_after\_IT_{it} + \delta_1 Debt_{it-1} + \phi X_{it} + v_i + n_t + \varepsilon_{it} \end{aligned}, \quad (2a)$$

$$\begin{aligned} Inflation_{it} = {} & \alpha + \beta\, Inflation_{it-1} + \lambda_1 IT\_only_{it} + \lambda_2 FR\_only_{it} + \lambda_3 IT\_\&\_FR_{it} \\ & + \lambda_4^1 IT\_after\_FR_{it} + \lambda_4^2 FR\_after\_IT_{it} + \phi X_{it} + v_i + n_t + \varepsilon_{it} \end{aligned}. \quad (2b)$$

Compared to (1a-b), equations (2a-b) measure not only the isolate effects of IT and FR, but equally their joint effects through analyzing the role of the interactions between them, as well as the influence of the timing of their adoption. These effects are captured by the inclusion of the five dummy variables emphasized above, representing all the different possible scenarios of IT and FR adoption. By so doing, we disaggregate the effect of IT and FR adoption from (1a-b) in three levels. First, coefficients λ_1 and λ_2 from regressions (2a-b) measure the effects of IT and FR adoption *exclusively* for the ITers not having enacted FR (coefficient λ_1) and the FRers not having adopted IT (coefficient λ_2).[11] Second, the sum between λ_3 (which captures the effect of the first regime, namely IT of FR) and alternatively λ_4^1 *or* λ_4^2 measures the contribution of the interaction between IT and FR to the effect of IT or FR adoption on

debt, consistently with a *credibility-signaling* effect with regard to financial markets' expectations (see Roger, 2009; or Freedman & Ötker-Robe, 2010).

[11] For comparison, in equations (1a-b), coefficient λ_1 measures the effect of IT (or FR) adoption for the ITers (or the FRers) *irrespective* of the decision to have adopted or not FR (IT). In addition, notice that we cannot measure interactions using traditional interactive variables, namely IT*FR, since the product of our two dummy variables IT and FR equals either IT or FR.

our outcome variables. For example, to see if interactions between IT and FR provided better outcome compared to IT (FR) adoption alone we compare λ_1 (λ_2) to the sum $\lambda_3 + \lambda_4^1$ or $\lambda_3 + \lambda_4^2$. Finally, λ_4^1 and λ_4^2 measure the contribution of the *timing of adoption* on our outcome variables, by accounting for differences between countries having adopted IT after FR (coefficient λ_4^1) and countries having enacted FR after IT (coefficient λ_4^2).

A key issue in isolating the causal effects in equations (1) and (2) is to address the likely endogeneity of the variables of interest, namely IT or FR in (1) and the five interaction and sequence variables in (2). The standard approach commonly used in the literature draws upon the impact analysis techniques, namely the *difference-in-difference* estimator (DID, see Ashenfelter & Card, 1985).[12] However, as stressed out by Bertrand, Duflo & Mullainathan (2004), running DID estimations in the presence of serial dependence in both the dependent variable (both fiscal balances and inflation are persistent over time, as reflected by the significant coefficients of the lagged variables in equations (1) and (2)) and in the treatment variable (no country abandoned Inflation Targeting yet due to economic duress pattern, for example), leads to misleading standard errors and are therefore inappropriate.[13]

Accordingly, we focus on an alternative major approach dealing with endogeneity issues, namely the use of instrumental variables. The performances of this technique are intimately related to the ability of identifying valid instruments for the variable of interest. However, given the difficulties in finding time-varying valid instruments for IT or FR, a reasonable compromise is to resort to the Generalized Method of Moments (GMM). In addition to tackling the endogeneity of the variable of interest, the use of the GMM estimator is particularly appropriate for our study involving dynamic panel models (see (1) and (2)).[14]

4. Results

We perform our estimations on the full sample for the period 1990-2009,[15] on five non-overlapping four-year periods to avoid an over-fit of the instruments due to a large

[12] An alternative technique often used is *matching on the propensity scores* (PS, see Rosenbaum & Rubin, 1983); however, this method is not appropriate here and especially for the estimation of equation (2), since (2) involves five *treatment* variables, instead of a unique *treatment* variable as required by the PS technique.

[13] For a recent discussion on the uncertainties associated with the use of DID, see Donald & Lang (2007).

[14] We use the two-step System GMM developed by Blundell & Bond (1998), with Windmeijer (2005) small sample robust correction, which combines two instrumentations: first, it instruments the first differences (which eliminates the time-invariant country-specific effects) of the equation of interest with their lagged (one period or more) values in levels, assuming that the error terms in the equation in levels are not serially correlated. Second, it uses the first difference of variables, lagged one or several periods, to instrument the variables in levels.

[15] We explored the possibility of accounting for the likely heterogeneity between countries by carrying out the estimations on developed and developing countries subsamples. However, due to lack of sufficient variability in

number of periods relative to the number of countries.[16] To assess the validity of the instrumentation, we present in each table standard diagnosis statistics, namely the second-order autocorrelation test AR(2) and the Hansen's overidentification test.

4.1. The effects of IT and FR adoption on fiscal performances (PFB and FB)

Table 1 depicts estimation results with the primary fiscal balance (PFB) as the dependent variable. First, remark that p-values for diagnostic tests are above the 10% threshold, supporting the absence of second-order autocorrelation for the error terms and the orthogonality between the instruments and the error term. Second, the coefficient of lagged PFB is statistically significant, confirming that the design and the implementation of fiscal policy exhibit persistence over time. In addition, the positive and significant estimated coefficient of the lagged government debt reveals that our fiscal policy reaction function fits well Bohn (1998)'s model, namely that the PFB is sensitive to the level of government debt. Finally, regarding control variables, the estimated coefficient of the output gap is not significant, suggesting that fiscal policy is acyclical for countries in our sample. In addition, the positive and significant effect of the growth rate of the terms of trade indicates that favorable external shocks are a significant source of government resources, and politically more stable countries present better fiscal balance (the coefficient of the variable government stability is significant in several regressions).

Let us now focus on our variables of interest. According to the first two columns of Table 1, which consider alternative specifications of equation (1a) with IT and FR as the variables of interest respectively, IT and FR adoption exert a positive and significant effect on the PFB. In particular, our results confirm the discipline-enhancing effect of FR previously emphasized in the literature (see, *e.g.*, Alesina & Perotti, 1995; Alesina et *al*., 1999; Debrun et *al*., 2007; Hallerberg et *al*., 2009; Dabla-Norris et *al*., 2010; or Gollwitzer, 2011). According to our estimations, countries having adopted IT improved their PFB by almost 2.42 percentage points of GDP, while enacting FR is found to have improved the PFB by 1.35 percentage points of GDP. However, the results emphasized in the first two columns of Table 1 suffer from an important shortcoming, namely they do no account for interactions between

the experiences of IT and FR adoption, particularly regarding the sequence of IT and FR adoption, we were forced to consider the full sample. Nevertheless, we use the status of development to control for heterogeneity.

[16] Averaging data over non overlapping four-year periods is a sensible compromise between giving enough time for the sluggish responses of macro variables and separating the effects of the variables of interest from the effects of other events occurring in close proximity (see Brito & Bystedt, 2010). If a country adopts IT or FR between the first and the third year of the four-year sub-period we consider this sub-period as the starting date of the framework, while if it adopts a framework in the last year of the four-year sub-period we consider the next sub-period as the starting date of the framework.

IT and FR; for example, the variable IT regroups all ITers, irrespective of the fact that they have adopted or not FR. We tackle this issue by presenting in column [3] estimations based on equation (2a).

Table 1: Effects of IT, FR, and their interactions, on the Primary Fiscal Balance (PFB)

Dependent Variable: Primary Fiscal Balance	**[1]**	**[2]**	**[3]**	**[4]**[a]	**[5]**
Lagged Primary fiscal balance	0.246***	0.293***	0.371***	0.389***	0.347***
	(0.079)	(0.056)	(0.074)	(0.059)	(0.060)
Lagged Debt/GDP	0.013*	0.015*	0.026***	0.020**	0.020**
	(0.007)	(0.009)	(0.010)	(0.008)	(0.009)
Inflation Targeting (IT) Dummy	**2.420*** **				
	(0.856)				
Fiscal Rule (FR) Dummy		**1.349****			
		(0.682)			
IT_only			**3.005*** **	**1.996*** **	**2.025****
			(1.086)	**(0.744)**	**(1.044)**
FR_only			**1.609*** **	**1.569*** **	**1.179***
			(0.569)	**(0.436)**	**(0.633)**
IT_&_FR			**2.993***	**4.260****	**1.999***
			(1.623)	**(1.891)**	**(1.052)**
IT_after_FR			**6.558****	**3.444***	**4.824***
			(3.106)	**(1.812)**	**(2.696)**
FR_after_IT			**-1.417**	**-2.553**	**-0.160**
			(1.836)	**(2.145)**	**(2.461)**
Time length between IT (FR) and FR (IT)					-0.213
					(0.137)
Output Gap	16.758	8.699	-9.791	-8.847	-7.578
	(14.864)	(7.807)	(8.485)	(7.600)	(8.705)
Trade Openness	-0.014	-0.010	-0.006	-0.006	-0.012*
	(0.014)	(0.008)	(0.008)	(0.006)	(0.007)
Growth Rate of Terms of Trade	9.721**	7.487**	5.949	2.571	6.596*
	(4.972)	(3.624)	(3.884)	(3.687)	(3.611)
Government Stability	0.480	0.468**	1.109***	1.044***	1.054***
	(0.400)	(0.239)	(0.218)	(0.227)	(0.268)
Logarithm of real per capita GDP	0.179	0.170	0.879	0.623	0.921
	(0.701)	(0.630)	(0.763)	(0.522)	(0.748)
Time Effects	Yes	Yes	Yes	Yes	Yes
Number of Observations	341	341	341	341	341
Arellano-Bond test for AR(2): p-value	0.147	0.299	0.427	0.459	0.550
Hansen test for over-identification: p-value	0.581	0.179	0.443	0.358	0.126

Note: The estimation method is two-step system GMM with Windmeijer (2005) small sample robust correction. Data are averaged over five non-overlapping four-year periods between 1990 and 2009. Standard errors are in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Output gap, logarithm of real per capita GDP, IT dummy, FR dummy, IT_only, FR_only, IT_&_FR, IT_after_FR, and FR_after_IT are treated as endogenous. Lagged primary fiscal balance, lagged debt/GDP, trade openness, government stability and the time length are treated as predetermined, while time effects and the growth rate of terms of trade are considered as exogenous. Constant included (but not reported). [a]: estimations carried out using *conservative*, instead of default, IT starting dates.

Our results show that countries having adopted only IT improved their PFB by roughly 3 percentage points of GDP (the coefficient of IT_only), while countries having enacted only FR improve their PFB by roughly 1.6 percentage points of GDP. For countries having adopted both frameworks, namely IT and FR, two cases emerged. On the one hand,

countries that enacted FR prior to IT adoption improved their PFB by roughly 9.5 percentage points of GDP (the sum of the coefficients of variables IT_&_FR and IT_after_FR). On the other hand, those that enacted FR after IT adoption improved their PFB by roughly 3 percentage points of GDP (the sum of the coefficients of variables IT_&_FR and FR_after_IT, the latter being non significant).

Based on these figures, our findings are the following. First, interactions between IT and FR adoption do exert an effect on the PFB. On the one hand, countries having adopted IT after enacting FR improve their PFB by almost 8 percentage points more on average compared to countries having adopted only FR (2.993+6.558 vs 1.609); this number measures the contribution of adopting IT in addition to enacting FR.[17] On the other hand, namely when FR are enacted after IT adoption, the performances in terms of PFB are not statistically different for countries having adopted both frameworks compared to countries having adopted only IT (the estimated coefficients are 2.993 and 3.005 respectively, and the p-value associated with that null hypothesis of statistically identical coefficients is 30.93%, namely above the critical threshold of 10%).[18] Second, the timing of adoption matters. According to our results, countries having adopted FR before IT improve their PFB by 6.5 percentage points (the coefficient of IT_after_FR) compared to countries having adopted FR after IT adoption which do not experience a significant improvement (the coefficient of FR_after_IT is not significant).

We check for the robustness of our results in three ways. First, regarding the IT starting date: compared to column [3] based on default IT starting dates, we present in column [4] estimations based on conservative IT starting dates. Remark that not only IT and FR adoption still exert a positive and significant effect on PFB (the coefficients of variables IT_only and FR_only equal 1.996 and 1.569 respectively), but also that the interaction and the timing of IT and FR adoption still significantly affect PFB. On the one hand, the PFB improvement in countries having adopted both IT and FR lies between 4.260 (for countries having enacted FR after IT) and 7.704 (for countries having adopted IT after FR, namely 4.260+3.444) percentage points of GDP, namely above the PFB improvement associated with

[17] Equality tests reject the null hypothesis of statistically identical coefficients, as the p-value associated with that null hypothesis is 0.52%, namely below the critical threshold of 10%, confirming that the sum (2.993+6.558) is significantly larger than 1.609. Similarly, countries having adopted IT after enacting FR improve their PFB by 6.5 percentage points larger on average compared to countries having adopted only IT (2.993+6.558 vs 3.005, with a p-value of 2.64% for the equality tests, yet again below the critical threshold of 10%); this number measures the contribution of enacting FR prior to IT adoption to the effect of IT adoption on PFB.

[18] However, PFB is increasing by almost 1.4 points in countries having enacted FR after adopting IT compared to countries having adopted only FR (the estimated coefficients are 2.993 and 1.609 respectively); this number measures the contribution of adopting IT prior to FR to the effect of enacting FR on PFB.

the adoption of IT or FR only (namely 1.996 and 1.569 respectively). On the other hand, we find, yet again, that only the timing which consists of adopting IT after FR has a significant effect on PFB (the coefficient of IT_after_FR equals 3.444).

The second robustness analysis focuses on the overall fiscal balance (FB), instead of the PFB, as measure of fiscal performance. Using the FB allows seizing a country's fiscal performance from a broader standpoint, as this measure, in addition to the fiscal outcome achieved by current fiscal policymakers, namely the PFB, accounts for fiscal performances attributable to past fiscal authorities, by adding interest payments. Estimations based on the FB are illustrated in Appendix 6, and confirm our results obtained for the PFB.[19] Indeed, columns [1]-[2] show that IT and FR adoption significantly improve the FB. Moreover, according to column [3] in Appendix 6, countries that adopted both IT and FR present better FB compared to countries that adopted only one of the two frameworks. Indeed, the joint effect of IT and FR is an increase of FB by at least 3.163 percentage points of GDP (when FR are enacted after IT) and up to 6.561 percentage points of GDP (when IT is adopted after FR, namely 3.163+3.398); for comparison, this favorable effect equals only 2.816 (1.260) percentage points for countries having adopted only IT (FR). Moreover, the timing of the adoption is not neutral, since only the strategy consisting of adopting IT after enacting FR leads to a significant improvement in FB, by roughly 3.4 percentage points. Finally, these results subsist when considering conservative, instead of default, starting dates in column [4] of Appendix 6.

Third, to ensure that we really capture the influence of the sequence of adoption, and not an effect potentially ascribable to the time length between IT (FR) adoption and FR (IT) adoption, we control for the time length elapsed between the adoptions of the two regimes. The underlying idea is that the effect of the joint adoption of both regimes may differ depending on whether or not the adoption of the second regime was announced - and hence anticipated by the private agents - at the beginning of the first regime. Undoubtedly, a key element determining the degree to which the private agents embed the forthcoming implementation of the second regime is the time length between the adoptions of the two regimes. Consequently, our tested hypothesis, consisting of capturing the influence of the sequence of adoption, and not of the time length between the adoptions of the two regimes, is

[19] Remark that that p-values for diagnostic tests support, yet again, the absence of second-order autocorrelation for the error terms and the orthogonality between the instruments and the error term, while control variables that were previously found as significantly influencing the PFB, namely the lagged debt-to-GDP ratio, the growth rate of terms of trade and the measure of government stability, equally affect the FB. In addition, the coefficient of lagged FB is positive and significant, supporting the presence of time persistence of the FB.

that the estimated effect of that latter variable is not statistically significant. Column [5] of Table 1 depicts the estimation results controlling for this time length. This new specification does not entail qualitative changes in our main results, regarding the influence of the interactions and of the sequence of adoption of IT and FR on the PFB. Of particular relevance, the estimated coefficient of the time length is not significantly different from zero, underlining the robustness of the role of the interactions and of the sequence of adoption of IT and FR in shaping the fiscal behaviors.

Consequently, a country that aims at adopting both IT and FR should carefully design the implementation of the two frameworks, since their effects on fiscal performance are not neutral. According to our estimations, performed alternatively on different measures of fiscal performance, namely the PFB or the FB, and different IT adoption starting dates, namely default and conservative, the strongest improvement in fiscal outcomes is associated with a strategy that consists of enacting FR before adopting an IT monetary framework.

4.2. The effects of IT and FR adoption on inflation

Let us now focus on the other major outcome measure of our study, namely *Inflation*. To mitigate the influence of outliers due to hyperinflation episodes, we followed previous studies (see, for example, Mishkin & Schmidt-Hebbel, 2002) and normalized the inflation rate as *Inflation*/(1+*Inflation*). Table 2 reports the estimation results using normalized inflation as the dependent variable.

Irrespective of the considered regression, the p-values associated with diagnostic tests support our strategy to correct for the endogeneity bias (see Table 2). In addition, the coefficient of the lagged inflation rate is strongly significant, confirming the persistence in inflation and thus our estimation strategy. Moreover, as expected, inflation is rising during periods of economic expansion, as emphasized by the coefficient of output gap, while countries with better institutions present lower inflation (according to the negative and significant coefficient of the variable government stability).

Regarding our main results, columns [6] and [7] reveal that adopting IT and enacting FR is effective in bringing down average (normalized) inflation, by an amplitude of 4.2 and 3.1 percentage points respectively. However, these results do not account for a possible effect of the interaction and/or the timing of adopting IT and FR on inflation; we address this shortcoming in column [8].

Table 2: Effects of IT, FR, and their interactions, on Inflation

Dependent Variable: Inflation Rate	**[6]**	**[7]**	**[8]**	**[9][a]**	**[10]**
Lagged Inflation Rate	0.450***	0.456***	0.465***	0.361***	0.512***
	(0.149)	(0.145)	(0.057)	(0.049)	(0.065)
Inflation Targeting (IT) Dummy	**-0.042****				
	(0.019)				
Fiscal Rule (FR) Dummy		**-0.031***			
		(0.016)			
IT_only			**-0.022****	**-0.032***	**-0.017***
			(0.009)	**(0.020)**	**(0.010)**
FR_only			**-0.012**	**-0.018**	**-0.012**
			(0.008)	**(0.013)**	**(0.011)**
IT_&_FR			**-0.026****	**-0.040***	**-0.029***
			(0.013)	**(0.023)**	**(0.016)**
IT_after_FR			**-0.013***	**-0.029***	**-0.021***
			(0.008)	**(0.017)**	**(0.012)**
FR_after_IT			**0.013**	**0.036**	**0.026**
			(0.011)	**(0.024)**	**(0.018)**
Time length between IT (FR) and FR (IT)					0.0003
					(0.0014)
Output Gap	0.602*	0.751**	0.214*	0.016	0.125
	(0.359)	(0.354)	(0.117)	(0.120)	(0.141)
Trade Openness	-0.00003	-0.00008	-0.00004	0.0002	0.00008
	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0001)
Terms of Trade Growth Rate	-0.042	-0.030	-0.101	-0.084	-0.063
	(0.108)	(0.108)	(0.070)	(0.067)	(0.086)
Government Stability	-0.018**	-0.018**	-0.011***	-0.016***	-0.013**
	(0.008)	(0.008)	(0.003)	(0.004)	(0.005)
Logarithm of Real per capita GDP	-0.004	-0.008	-0.008*	-0.010	-0.007
	(0.011)	(0.012)	(0.005)	(0.007)	(0.007)
Time Effects	Yes	Yes	Yes	Yes	Yes
Number of Observations	500	500	500	500	500
Arellano-Bond test for AR(2): P-value	0.981	0.828	0.969	0.823	0.976
Hansen test for over-identification: P-value	0.136	0.105	0.227	0.186	0.233

Note: The estimation method is two-step system GMM with Windmeijer (2005) small sample robust correction. Data are averaged over five non-overlapping four-year periods between 1990 and 2009. Standard errors are in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Output gap, logarithm of real per capita GDP, IT dummy, FR dummy, IT_only, FR_only, IT_&_FR, IT_after_FR, and FR_after_IT are treated as endogenous. Lagged inflation rate, trade openness, government stability and the time length are treated as predetermined, while time effects and the growth rate of terms of trade are considered as exogenous. Constant included (but not reported). [a]: estimations carried out using *conservative*, instead of default, IT starting dates.

Estimations show that the adoption of an IT monetary regime significantly reduces the inflation rate; countries having adopted only IT experienced a drop in their average (normalized) inflation rates by 2.2 percentage points, in addition to presenting better fiscal balances (see Table 1 and Appendix 6). Contrary to their positive effect on PFB (or FB), enacting only FR is not found to significantly act on inflation performances (the coefficient of FR_only has the expected negative sign but is not significant), suggesting that the adoption of FR alone is not sufficiently binding to reduce inflation.

Moreover, we provide an evaluation of the effect of the interaction and of the timing of IT and FR adoption, regarding inflation performances. It appears that countries having adopted both IT and FR experienced a larger decrease in their inflation rates, compared to countries having adopted only IT. Compared to countries that adopted only IT, which see their (normalized) inflation decrease by 2.2 percentage points, the decrease in inflation is stronger for countries having adopted both frameworks: 3.9 (2.6+1.3) percentage points for those who first enacted FR before adopting IT and 2.6 (2.6-1.3, the latter coefficient being non significant) percentage points for those having first adopted IT before enacting FR.[20] Consequently, there is evidence that not only IT and FR act complementarily to bring down average inflation, but also that the timing of adoption matters, since a strategy which consists of adopting IT after enacting FR leads to significantly better inflationary results compared to the reversed strategy.

To assess the robustness of our results, we present in column [9] estimations that consider the conservative starting dates of IT (instead of default starting dates in [8]). Recall that conservative starting dates, which offer a more restrictive measure for the beginning of an IT regime regarding the fulfillment of reforms, are located after the default starting dates of IT for all the countries in our sample for which there exist such different dates. Consequently, we expect inflation to decrease more in response to the adoption of the IT framework, compared to results based on default starting dates.

First, observe that adopting only IT not simply decreases inflation, but the inflation decrease is stronger compared to the case of default IT starting dates (the associated coefficients are -0.032 and -0.022 respectively); in addition, adopting FR only has still no significant effect on inflation. Second, when using conservative starting dates, the adoption of both IT and FR is always better for inflation compared to adopting IT only. In the worst case, namely when FR are enacted after IT, the adoption of the two frameworks decreases (normalized) inflation by 4.0 percentage points (the sum of the coefficients of IT_&_FR and of FR_after_IT, the latter being not significant), which is larger than the decrease in inflation associated with adopting IT only (3.2 percentage points). However, in the best case, namely when IT is adopted after FR, the decrease in inflation is as high as 6.9 percentage points (the sum of the coefficients of IT_&_FR and of IT_after_FR), significantly above the 3.2 percentage points decrease when adopting IT only. Third, accounting in regression [9] for conservative, instead of default starting IT dates in [8], slightly improves the effects arising from the timing of IT and FR adoption. Indeed, although the coefficient of FR_after_IT is still

[20] The p-values associated with the equality tests (3.9 vs. 2.2 and 2.6 vs. 2.2) are 0.88% and 17.67% respectively.

not significant, the coefficient of IT_after_FR is still negative and of higher magnitude in [9] (namely -0.029), compared to its value in [8] (namely -0.013). Consequently, accounting for conservative instead of default starting IT dates improves the estimated effects of the timing variables, since their contribution to reducing inflation is stronger when IT and FR are jointly at work.

Finally, analogously with the results using the PFB as outcome variable, we also check for the robustness of our results with respect to the inclusion of the time length between the adoption of IT and FR. This specification (see column [10], Table 2) does not qualitatively change the estimated influence of the interactions and sequence of adoption of IT and FR on inflation dynamics.

5. Conclusion

We explored in this paper the fiscal and inflationary effects of Inflation Targeting (IT) and national-level fiscal rules (FR). This is the first study which accounts explicitly for the role of the interactions between IT and FR and of the sequence of adoption of the two frameworks, regarding inflation and fiscal performances. We performed our analysis on a wide panel dataset of 152 developed and developing countries over the period 1990-2009, using a System GMM estimator to account for the persistence in inflation dynamics and in fiscal policy, and for the endogeneity of IT and FR adoption. Our major results are: (i) the interaction between IT and FR does matter for their effects on fiscal balances and on inflation, suggesting that some complementarity between these two rule-based policy frameworks is at work, consistently with the literature on the unpleasant monetarist arithmetic (Sargent & Wallace, 1981) or on the fiscal theory of the price level (Woodford, 1994; and (ii) the timing of adoption of IT and FR is not neutral regarding their fiscal and inflationary effects.

Our analysis suggests that, to draw policy implications, one should consider not only the interactions between IT and FR, but also the timing of adoption of the two frameworks. First, IT adoption, in addition to its primary usefulness for achieving price stability, is a good device for improving fiscal performances. Second, enacting FR is a credible strategy for improving fiscal performance, but not sufficiently constraining for the central bank to rule-out the inflation bias and to bring down average inflation. Third, adopting both IT and FR leads to remarkably better fiscal and inflationary performances in a vast majority of cases, compared to enacting either only IT or only FR (in the worst cases differences are not statistically significant compared to the case of IT only or FR only). Nevertheless, adopting both IT and FR may leave policymakers with not enough room for smoothing the economy in case of a

contractionary shock. Such a concern arose during the recent global recession and financial crisis, and needs therefore to be carefully addressed in future research. Fourth, when considering the prospect of adopting both IT and FR, it is preferable for countries to *first introduce FR before adopting IT* than first adopting IT before enacting FR, as the fiscal and inflationary performances associated with the former strategy outweigh those associated with the latter strategy.

Finally, our findings shed a new perspective on the classical Barro & Gordon (1983) game between the Government and the Central Bank, who focus independently on fiscal and monetary goals respectively. According to our analysis, which accounts for possible interactions between the policies of the two institutions, namely FR and IT adoption, both the Government and the Central Bank can find incentives in implementing their policies on a cooperative basis, since the strategy which consists of first letting the Government enact FR and then allowing the Central Bank adopting an IT monetary regime dominates, in terms of fiscal and monetary performances, all alternative strategies, namely the reversed timing or corner strategies consisting of only one policy (IT only or FR only).

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Appendices

Appendix 1: Comparative description of IT and FR institutional parameters

	Inflation Targeting (IT)	Fiscal Rules (FR)
Starting dates	Early 1990s, namely in 1990 in New Zealand.	The new wave of FR started in the early 1990s, namely in 1994 in New Zealand.
Nature	Numerical targets on inflation.	Numerical targets on fiscal aggregates.
Targets Horizon	Annual, Medium term, or Over the business cycle, etc.	Annual, Medium term, or Over the business cycle, etc.
Statutory basis (or legal origin)	Institutional commitment to price stability as the primary objective of monetary policy (Enshrined in the Constitution in some countries; regular explanations by central bankers) in the National Parliament).	FR adoption needs to be accompanied by a strong institutional infrastructure, either enshrined in the Constitution, or in a Fiscal Responsibility Law, or resulting from a political commitment.
Transparency	Regular communications with the public regarding policy objective, orientation, decisions and results (publication of inflation reports, inflation projections, minutes of monetary policy meetings, etc.).	Mandatory publication of regular reports that must contain multiyear fiscal projections and other pre-determined disclosures; Transparency Law.
Accountability	Greater accountability of central bankers in achieving the inflation target; Public explanation of target breach and measures taken to bring inflation within the target; In New Zealand for example, the Governor can be dismissed by Minister of Finance if he is proved to be accountable for missing the target.	Monitoring mechanisms, including the establishment of independent fiscal agencies (or councils); Fiscal responsibility Laws; Internal and external audit systems.
Escape clauses	Revision of target path under "Exceptional circumstances" (major oil price shocks, natural disasters, unusual events provided they do not cause general inflationary pressures); Use of core inflation targets.	"Exceptional circumstances clause" that allows a temporary deviation from the rule in the face of a rare shock, or even to deal with the fiscal impact of major structural reforms (e.g., civil service reform); Use of cyclically-adjusted balances rules.
Sanctions	Formal sanctions (dismissal of the central bank governor); Reputation cost: loss of credibility.	Formal sanction (credit restrictions, and personal fines, dismissal, and penal prosecution); Reputation cost (loss of credibility).

Sources: Mishkin & Schmidt-Hebbel (2002), Roger & Stone (2005), Roger (2009) for IT, and Debrun et *al.* (2008) and IMF (2009) for FR.

Appendix 2: Country List

Albania, Algeria, Angola, Argentina, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Benin, Bolivia, Botswana, Brazil, Brunei, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Cape Verde, Central African Rep., Chad, Chile, China, Columbia, Congo Democratic Rep., Congo Rep., Costa Rica, Côte d'Ivoire, Croatia, Cyprus, Czech Rep., Denmark, Dominica, Dominican Rep., Ecuador, Egypt, El Salvador, Equatorial Guinea, Estonia, Ethiopia, Fiji, Finland, France, Germany, Gabon, Gambia, Georgia, Ghana, Greece, Grenada, Guatemala, Guinea-Bissau, Guyana, Haiti, Honduras, Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italia, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Korea Rep., Kuwait, Kyrgyz Rep., Lao PDR, Latvia, Lesotho, Libya, Lithuania, Luxembourg, Madagascar, Malawi, Malaysia, Mali, Malta, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russian Federation, Rwanda, Saudi Arabia, Senegal, Seychelles, Singapore, Slovak Rep., Slovenia, Solomon Islands, South Africa, Spain, Sri Lanka, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Sudan, Suriname, Swaziland, Sweden, Switzerland, Syrian Arab Rep., Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, United Kingdom, United States, Uruguay, Venezuela, Vietnam, Yemen Rep., Zambia.

Appendix 3: Countries having adopted *IT* and *FR* along with their starting dates (Default starting dates / Conservative starting dates)

ITer	FRer	IT_only	FR_only	IT_&_FR	IT_after_FR	FR_after_IT
Australia (1993/1994)	Angola (2005)		Angola (2005)	Australia (1993/1994)		
Brazil (1999/1999)	Argentina (2000)		Argentina (2000)	Brazil (1999)		
Canada (1991/1992)	Australia (1998)			Canada (1991/1992)		Australia (1998/1998)
Chile (1991/1999)	Austria (1999)		Austria (1999)	Chile (1991/1999)		Chile (2000/2000)
Columbia (1999/1999)	Belgium (1992)	Columbia (1999/1999)	Belgium (1992)			
Czech Republic (1998/1998)	Botswana (2003)		Botswana (2003)	Czech Republic (1998/1998)		
Finland* (1993/1994)	Brazil (2000)			Finland* (1993/1994)		Brazil (2000/2000)
Ghana (2007/2007)	Bulgaria (2003)	Ghana (2007/2007)	Bulgaria (2003)			
Guatemala (2005/2005)	Canada (1998)	Guatemala (2005/2005)				Canada (1998/1998)
Hungary (2001/2001)	Cape Verde(1998)		Cape Verde(1998)	Hungary (2001/2001)		
Iceland (2001/2001)	Chile (2000)			Iceland (2001/2001)		
Indonesia (2005/2005)	Costa Rica (2001)		Costa Rica (2001)	Indonesia (1967/1967)	Indonesia (2005/2005)	
Israel (1992/1997)	Czech Republic (2005)			Israel (1992/1992)	Israel (1992/1997)	Czech Republic (2005/2005)
Korea, Rep (1998/1998)	Denmark (1992)	Korea, Rep (1998/1998)	Denmark (1992)			
Mexico (1999/2001)	Ecuador (2003)		Ecuador (2003)	Mexico (1999/2001)		
New Zealand (1990/1990)	Equatorial Guinea (2007)		Equatorial Guinea (2007)	New Zealand (1990/1990)		
Norway (2001/2001)	Estonia (1993)		Estonia (1993)	Norway (2001/2001)	Norway (2001/2001)	Norway (2001/2001)
Peru (2002/2002)	Finland (1995)			Peru (2000/2000)	Peru (2002/2002)	Finland (1995/1995)
Philippines (2002/2002)	France (1998)	Philippines (2002/2002)	France (1998)			
Poland (1998/1998)	Germany (1972)		Germany (1972)	Poland (1997/1997)	Poland (1998/1998)	
Romania (2005/2005)	Hungary (2007)	Romania (2005/2005)				Hungary (2007/2007)
Slovak Republic* (2005/2005)	Iceland (2004)			Slovak Republic* (2002/2002)	Slovak Republic * (2005/2005)	Iceland (2004/2004)
South Africa (2000/2000)	India (2004)	South Africa (2000/2000)	India (2004)			
Spain* (1995/1995)	Indonesia (1967)			Spain* (1995/1995)		
Sweden (1993/1995)	Israel (1992)			Sweden (1993/1995)		
Switzerland (2000/2000)	Ireland (2000)		Ireland (2000)	Switzerland (2000/2000)		
Thailand (2000/2000)	Japan (1947)	Thailand (2000/2000)	Japan (1947)			
Turkey (2006/2006)	Kenya (1997)	Turkey (2006/2006)	Kenya (1997)			
United Kingdom (1992/1992)	Lithuania (1997)		Lithuania (1997)	United Kingdom (1992/1992)		

Appendix 3 (continued): Countries having adopted IT and FR along with their starting dates (Default starting dates / Conservative starting dates)

ITer	FRer	IT_only	FR_only	IT_&_FR	IT_after_FR	FR_after_IT
	Luxembourg (1990)		Luxembourg (1990)			
	Madagascar (2006)		Madagascar (2006)			
	Mauritius (2008)		Mauritius (2008)			
	Mexico (2006)		Namibia (2001)			Mexico (2006/2006)
	Namibia (2001)		Nigeria (2004)			
	Netherlands (1994)		Netherlands (1994)			
	New Zealand (1994)					New Zealand (1994/1994)
	Nigeria (2004)					
	Norway (2001)					
	Pakistan (2005)		Pakistan (2005)			
	Panama (2002)		Panama (2002)			
	Peru (2000)					
	Poland (1997)					
	Portugal (2002)		Portugal (2002)			
	Slovak Republic (2002)					
	Slovenia (2000)		Slovenia (2000)			
	Spain (2002)					Spain (2002/2002)
	Sri Lanka (2003)		Sri Lanka (2003)			
	Sweden (1996)					Sweden (1996/1996)
	Switzerland (2003)					Switzerland (2003/2003)
	United Kingdom (1997)					United Kingdom (1992/1992)
	United States of America^{+} (1990)		United States of America^{+} (1990)			

*: Finland, Spain and Slovak Republic abandoned their IT to join the Euro Area respectively in 1999 (Finland and Spain) and 2009. $^{+}$: The United States of America enacted FR in 1990 but abandoned it in 2002, so as Belgium in 1992 and 1999 respectively. Norway adopted IT and FR in the same year, 2001, so we set variables IT_&_FR, IT_after_FR and FR_after_IT simultaneously equal to 1 after both IT and FR adoption (in 2001). Armenia, Comoros, Hong Kong, Liberia, and Timor-Leste also adopted FR but due to lack of available fiscal and/or inflation data (which constitute one of our dependent variables), they are not included in our sample. Serbia adopted IT in 2006, but due to lack of data on fiscal balance, this country is dropped from the sample.
Data Sources: Rose (2007) and Roger (2009) for IT starting dates, and IMF (2009) for FR starting dates.

Appendix 4: Sources and definitions of data

Inflation rate	Annual growth rate of average CPI	World Economic Outlook (2010)
Overall fiscal balance (FB)	Difference between general government revenue (including grants) and expenditure, as GDP percentage.	
Primary fiscal balance (PFB)	Difference between general government revenue (including grants) and expenditure (excluding interest payments), as GDP percentage.	
Full-Fledged or Formal IT (conservative starting dates)	Binary variable taking the value 1 if in a given year a country operates formally under IT, and zero otherwise. When we use conservative starting dates of IT we refer to full-fledged IT.	Rose (2007) and Roger (2009)
Soft or Informal IT (default starting dates)	Binary variable taking the value 1 if in a given year a country operates informally under IT, and zero otherwise. When we use default starting dates of IT we refer to soft IT.	
Fiscal rule dummy (FR)	Binary variable taking the value 1 if a country placed, at the national level, a numerical limit on fiscal aggregates (fiscal balance, expenditure, revenue or debt)	Fiscal Rules Database of the IMF's Fiscal Affairs Department, Fiscal Policy and Surveillance Division (2009)
Trade openness	Sum of imports and exports divided by GDP	Penn World Table (PWT.6.3)
Real per capita GDP	Real per capita GDP at constant prices. Proxy for a country's stage of development.	
Public Debt (% of GDP)	Gross General government debt, in percentage of GDP	Ali Abbas et al. (2010)
Government stability	Index ranging from 0 to 12 and measuring the ability of government to stay in office and to carry out its declared program(s). The higher the index, the more stable the government is.	International Country Risk Guide (ICRG, 2009)
Output gap	Difference between the logarithm of real GDP and the logarithm of a Hodrick-Prescott filtered trend of real GDP (with 100 as smoothing parameter, given the annual frequency).	Authors' calculations, based on data from WDI (2010)
Growth Rate of Terms of Trade	Annual relative change in the terms of trade	

Appendix 5: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Inflation Targeting Dummy (IT)	4,925	0.063	0.244	0	1
Fiscal Rule Dummy (FR)	4,725	0.118	0.323	0	1
IT_only	4,925	0.015	0.120	0	1
FR_only	4,925	0.073	0.261	0	1
IT_&_FR	4,925	0.053	0.224	0	1
IT_after_FR	4,925	0.011	0.106	0	1
FR_after_IT	4,925	0.033	0.178	0	1
Inflation rate	3,641	50.728	645.854	-17.640	24,411.03
Normalized inflation: Inflation/(1+Inflation)	3,641	0.100	0.152	-0.214	0.996
Overall fiscal balance (GDP %)	2,997	-2.143	7.522	-151.309	121.838
Primary fiscal balance (GDP %)	2,783	0.742	7.304	-147.492	123.181
Debt (GDP %)	3,719	69.524	65.306	0.318	2,092.922
Trade openness	3,969	82.788	48.722	1.086	456.562
Terms of Trade Growth Rate	3,883	0.017	0.382	-0.942	17.921
Output Gap	2,789	-0.004	0.054	-0.620	0.238
Real per capita GDP	3,969	9,946.41	11,187.57	153.16	88,292.58

Appendix 6: The effects of IT, FR, and their interactions, on the FB

Dependent Variable: Overall Fiscal Balance	**[1]**	**[2]**	**[3]**	**[4]**[a]
Lagged Overall fiscal balance	0.334***	0.307***	0.317***	0.374***
	(0.060)	(0.090)	(0.078)	(0.052)
Lagged Debt/GDP	0.015*	0.015*	0.009*	0.022***
	(0.009)	(0.009)	(0.006)	(0.008)
Inflation Targeting (IT) Dummy	**2.170*** **			
	(0.644)			
Fiscal Rule (FR) Dummy		**1.266****		
		(0.646)		
IT_only			**2.816*** **	**2.144****
			(0.862)	**(0.838)**
FR_only			**1.260****	**0.646***
			(0.573)	**(0.340)**
IT_&_FR			**3.163***	**1.577***
			(1.836)	**(0.830)**
IT_after_FR			**3.398***	**4.043***
			(1.788)	**(2.128)**
FR_after_IT			**-1.367**	**-0.449**
			(1.774)	**(1.942)**
Output Gap	17.254**	21.691*	13.034	-2.650
	(8.022)	(11.416)	(8.594)	(13.038)
Trade Openness	-0.004	-0.001	0.001	-0.001
	(0.009)	(0.011)	(0.009)	(0.008)
Growth Rate of Terms of Trade	13.589***	13.450**	7.991*	10.157**
	(3.942)	(5.361)	(4.396)	(4.027)
Government Stability	0.882***	0.908***	1.324***	1.158***
	(0.264)	(0.320)	(0.291)	(0.236)
Logarithm of real per capita GDP	-0.009	-0.211	0.295	0.611
	(0.514)	(0.592)	(0.669)	(0.577)
Time Effects	Yes	Yes	Yes	Yes
Number of Observations	351	351	351	351
Arellano-Bond test for AR(2): P-value	0.186	0.169	0.351	0.259
Hansen test for over-identification: P-value	0.172	0.193	0.306	0.103

Note: The estimation method is two-step system GMM with Windmeijer (2005) small sample robust correction. Data are averaged over five non-overlapping four-year periods between 1990 and 2009. Standard errors are in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Output gap, logarithm of real per capita GDP, IT dummy, FR dummy, IT_only, FR_only, IT_&_FR, IT_after_FR, and FR_after_IT are treated as endogenous. Lagged overall fiscal balance, lagged debt/GDP, trade openness and government stability are treated as predetermined, while time effects and the growth rate of terms of trade are considered as exogenous. Constant included (but not reported). [a]: estimations carried out using *conservative*, instead of default, IT starting dates.